US EPA Mid-Continent Ecology Division

Research Project Summary

Assessment of the Effects of Persistent Bioaccumulative Toxic Chemicals in Aquatic Ecosystems

Overview

The ecological risks of persistent bioaccumulative toxicants (PBTs) are best expressed and assessed using the chemical concentration in the organism and/or one of its tissues. However, EPA and other regulatory agencies manage the risks of PBTs using chemical concentrations in water and sediment. The connection between chemical concentrations in water and sediment to those in aquatic organisms is expressed using bioaccumulation factors (BAFs) and biota-sediment accumulation factors (BSAFs). The BAF and BSAF are simply ratios of the chemical concentrations in the aquatic organism to water and sediment, respectively. This research effort is focused on developing a hybrid modeling approach using empirical field data and bioaccumulation models to extrapolate BAFs and BSAFs for PBTs across ecosystems, species, and time. The overall research objective is to be able to make high quality site specific predictions of bioaccumulation using minimal amounts of field data. To develop the hybrid modeling approach, research is proceeding along several lines of investigation.

First, methods are being developed to visualize and examine bioaccumulation data, and relationships between critical residues in fish (threshold between acceptable and unacceptable) and chemical concentrations in water and sediment. Second, we are developing a high quality data set for PCBs, PCDDs, and PCDFs in the southern Lake Michigan ecosystem, i.e., the complete food web, water, and sediment. Third, the Lake Michigan data set will be used to derive a high quality data set of BAFs and BSAFs for PCBs, PCDDs, and PCDFs including important chemicals like PCBs 126 and 169, and 2,3,7,8-TCDD and -TCDF. Fourth, the Lake Michigan data will be used to demonstrate that BSAFs are well behaved in fish, and the utility of BSAFs in site specific applications. Fifth, we will test and evaluate extrapolation techniques for BAFs and BSAFs by extrapolating the Lake Michigan to other ecosystems. Sixth, we will determine how to account for metabolism in bioaccumulation predictions and extrapolations across ecosystems, species, and time.

Key Products

Cook PM, Robbins J, Endicott DD, Lodge KB, Walker MK, Zabel EW, Guiney PD, and Peterson RE. 2003. Effects of aryl hydrocarbon receptor mediated early life stage toxicity on lake trout reproduction in Lake Ontario during the 20th Century. Environ Sci Technol. 37(17):3864-3877.

Burkhard LP, Cook PM, and Mount DR. 2003. The relationship of bioaccumulative chemicals in water and sediment to residues in fish: A visualization approach. Environ Toxicol Chem. 22(11). (In press)

Burkhard LP, Cook PM, and Lukasewycz MT. 2003. BSAFs for PCBs, PCDDs, and PCDFs in southern Lake Michigan lake trout (*Salvelinus namaycush*). Environ Sci Technol. (In preparation)

Cook PM and Mount DR. 2004. Criteria applications and extrapolation of bioaccumulation data using the visualization approach for bioaccumulation. (In preparation)

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